

This Page Is Inserted by IFW Operations  
and is not a part of the Official Record

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning documents *will not* correct images,  
please do not report the images to the  
Image Problem Mailbox.**

## PATENT COOPERATION TREATY

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents  
 United States Patent and Trademark  
 Office  
 Box PCT  
 Washington, D.C. 20231  
 ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 04 October 1999 (04.10.99)	
International application No. PCT/NZ98/00098	Applicant's or agent's file reference 130
International filing date (day/month/year) 10 July 1998 (10.07.98)	Priority date (day/month/year) 20 February 1998 (20.02.98)
Applicant WITEHIRA, Pita et al	

1. The designated Office is hereby notified of its election made:



in the demand filed with the International Preliminary Examining Authority on:

31 August 1999 (31.08.99)



in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO  
 34, chemin des Colombettes  
 1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Lazar Joseph Panakal

Telephone No.: (41-22) 338.83.38

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>130</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/NZ 98/ 00098</b>	International filing date (day/month/year) <b>10/07/1998</b>	(Earliest) Priority Date (day/month/year) <b>09/04/1997</b>
Applicant  <b>WITEHIRA, Pita et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. ☐ **Certain claims were found unsearchable** (see Box I).

2. ☐ **Unity of invention is lacking** (see Box II).

3. ☐ The international application contains disclosure of a **nucleotide and/or amino acid sequence listing** and the international search was carried out on the basis of the sequence listing

☐ filed with the international application.

☐ furnished by the applicant separately from the international application,

☐ but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.

☐ Transcribed by this Authority

4. With regard to the **title**, ☒ the text is approved as submitted by the applicant

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this International Search Report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is:

Figure No. 1 ☐ as suggested by the applicant.

☐ None of the figures.

☒ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

## INTERNATIONAL SEARCH REPORT

International Application No.

PCT/NZ 98/00098

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 G02B27/22 H04N13/00

According to International Patent Classification(IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 G02B H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	WO 91 12554 A (RAYCHEM CORP) 22 August 1991 see the whole document	1, 2, 8, 9  6, 7, 11-14, 17, 18, 21
X  A	----- TOMOHIKO HATTORI ET AL: "SPATIAL MODULATION DISPLAY USING SPATIAL LIGHT MODULATORS" OPTICAL ENGINEERING, vol. 31, no. 2, 1 February 1992, pages 350-352, XP000257543 see the whole document  ----- -/--	1       2, 6-8, 11-14, 17, 18, 21



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

## ° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

30 September 1998

Date of mailing of the international search report

08/10/1998

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Ward, S

## INTERNATIONAL SEARCH REPORT

International Application No.

PCT/JP 98/00098

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 012, no. 102 (P-684), 5 April 1988 & JP 62 235929 A (STANLEY ELECTRIC CO LTD), 16 October 1987	1
A	see abstract; figure	2,6-8, 11-14, 17,18,21
X	EP 0 454 423 A (TFE HONG KONG LIMITED) 30 October 1991	1
A	see the whole document	2,6-8, 11-14, 17,18,21
X	PATENT ABSTRACTS OF JAPAN vol. 015, no. 019 (P-1153), 16 January 1991 & JP 02 262119 A (NEC CORP), 24 October 1990	1
A	see abstract; figure	2,6-8, 11-14, 17,18,21
X	EP 0 195 584 A (TEKTRONIX INC) 24 September 1986	1,6,8
A	see the whole document	2,7, 11-14, 17,18,21
X	WO 91 15930 A (RAYCHEM CORP) 17 October 1991	1,6
A	see the whole document	2,7,8, 11-14, 17,18,21
X	US 4 472 737 A (IWASAKI KENJI) 18 September 1984	1
A	see the whole document	2,6-8, 11-14, 17,18,21
X	US 4 333 715 A (BROOKS PHILIP A) 8 June 1982	1,2,8
A	see the whole document	6,7, 11-14, 17,18,21
A	US 5 557 684 A (WANG JOHN Y A ET AL) 17 September 1996 see the whole document	17,18

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/NZ 98/00098

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9112554	A	22-08-1991	US 5113272 A	12-05-1992
			AT 122157 T	15-05-1995
			CA 2075807 A	13-08-1991
			DE 69109471 D	08-06-1995
			DE 69109471 T	01-02-1996
			EP 0515533 A	02-12-1992
			JP 5504210 T	01-07-1993
EP 0454423	A	30-10-1991	GB 2245092 A	18-12-1991
EP 0195584	A	24-09-1986	US 4670744 A	02-06-1987
			CA 1257025 A	04-07-1989
			JP 61212821 A	20-09-1986
WO 9115930	A	17-10-1991	NONE	
US 4472737	A	18-09-1984	NONE	
US 4333715	A	08-06-1982	US 4294516 A	13-10-1981
US 5557684	A	17-09-1996	JP 7095592 A	07-04-1995

13

**PATENT COOPERATION TREATY**  
**PCT**  
**INTERNATIONAL PRELIMINARY EXAMINATION REPORT**  
(PCT Article 36 and Rule 70)

**CORRECTED VERSION**  
REC'D 04 JUL 2000  
WIPO PCT

Applicant's or agent's file reference 15994/3X058	<b>FOR FURTHER ACTION</b>	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International application No. <b>PCT/NZ98/00098</b>	International filing date ( <i>day/month/year</i> ) 10 July 1998	Priority Date ( <i>day/month/year</i> ) 20 February 1998
International Patent Classification (IPC) or national classification and IPC  <b>Int. Cl. <sup>7</sup> G02B 27/22, H04N 13/00</b>		
Applicant <b>[WITEHIRA, Pita et al] POWER BEAT INTERNATIONAL LIMITED</b>		

1.	This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2.	This REPORT consists of a total of 5 sheets, including this cover sheet.  <input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).  These annexes consist of a total of 2 sheet(s).
3.	This report contains indications relating to the following items:  I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input checked="" type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input checked="" type="checkbox"/> Certain defects in the international application VIII <input type="checkbox"/> Certain observations on the international application

**CORRECTED  
VERSION**

Date of submission of the demand 31 August 1999	Date of completion of the report 20 June 2000 [NOTE: This is a replacement for the Report issued on 10 March 2000]
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer  <b>M.E. DIXON</b>  Telephone No. (02) 6283 2194

**I. Basis of the report****1. With regard to the elements of the international application:\***

- ☐ the international application as originally filed.
- ☒ the description, pages 1-12, as originally filed,  
pages , filed with the demand,  
pages , received on with the letter of
- ☒ the claims, pages , as originally filed,  
pages , as amended (together with any statement) under Article 19,  
pages , filed with the demand,  
pages 13, 14, received on 16 June 2000 with the letter of 16 June 2000
- ☒ the drawings, pages 1-7, as originally filed,  
pages , filed with the demand,  
pages , received on with the letter of
- ☐ the sequence listing part of the description:  
pages , as originally filed  
pages , filed with the demand  
pages , received on with the letter of

**2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.**

These elements were available or furnished to this Authority in the following language which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

**3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, was on the basis of the sequence listing:**

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

**4. ☒ The amendments have resulted in the cancellation of:**

- ☐ the description, pages
- ☒ the claims, Nos. 17-21
- ☐ the drawings, sheets/fig.

**5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\***

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report



**III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability**

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be nonobvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application,

☒ claims Nos: 16

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

☐ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. are so unclear that no meaningful opinion could be formed (*specify*):

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☒ no international search report has been established for said claim Nos. 16

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

☐ the written form has not been furnished or does not comply with the standard.

☐ the computer readable form has not been furnished or does not comply with the standard.

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. Statement**

Novelty (N)	Claims 1-7, 9-15	YES
	Claims 8	NO
Inventive step (IS)	Claims 1-7, 10-15	YES
	Claims 8, 9	NO
Industrial applicability (IA)	Claims 1-15	YES
	Claims	NO

**2. Citations and explanations (Rule 70.7)**

In a first aspect as claimed in claim 1 and claims appended thereto the invention is to a display using multi-layered images each layer formed by a display device in which the foreground screen is selectively transparent and with a slightly diffuse layer placed on the front of a background image.

In a second aspect as claimed in claim 7 and claims appended thereto the invention is to a display using multi-layered images each layer formed by a display device in which the foreground screen is selectively transparent and with layered images being aligned such that a 45 degree angle can be measured in relation to their respective pixel alignment configurations.

The combination of features as claimed in these claims is not disclosed in the cited art.

The invention in claim 8 and claims appended thereto is a display using multi-layered images each layer formed by a combination of transmissive polarised display devices in which the foreground screen is selectively transparent and one or more internally facing polariser is removed.

Claim 8 lacks novelty in view of US 4333715. Figure 2 of this citation shows a combination of polarised display devices, the first formed by polariser 20, glass 24, liquid crystal 30 and the second formed by 22, 28, 32. The first is the foreground screen which is selectively transparent (col 7 lines 24-33) and polariser 20 is transmissive (col 6 line 34). The second polariser 22 is reflective but, in another embodiment, is made transmissive by a plurality of small holes dispersed throughout (col 8 lines 27-54). In the embodiment first described with reference to fig 2 member 26 is glass instead of polariser (col 7 lines 4-6) - in other words the internally facing polariser is removed. Therefore all the features of claim 8 are found in this citation.

Claim 9 lacks inventive step in view of the above citation since the introduction of an object to block light would be obvious to a skilled person.

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

Claim 16 relies on reference to description and drawings (Rule 6.2 (a)).

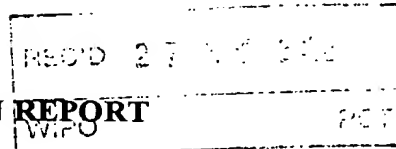
## CLAIMS

1. A display using multi-layered images each layer formed by a display device or combination of display devices in which the foreground screen(s) is(are) selectively transparent and with a slightly diffuse layer placed on the front of a background image.
2. A display as claimed in Claim 1 which has a refractor between layers.
3. The display as in Claim 2 with said refractor being of optically clear material placed between images such that the image in the foreground is no less than 45 degrees from the edge of the screen to its rear.
4. The display as in Claim 2 with said refractor being a fresnel lens.
5. The display as in either Claim 2 or Claim 3 with said refractor diffused on the side facing the rear screen.
6. A display as claimed in Claim 1 wherein the space between images is able to be adjusted in real time.
7. A display using multi-layered images each layer formed by a display device or combination of display devices in which the foreground screen(s) is(are) selectively transparent with layered images being aligned such that a 45 degree angle can be measured in relation to their respective pixel alignment configurations.
8. A display using multi-layered images each layer formed by a combination of transmissive polarized display devices in which the foreground screen(s) is (are) selectively transparent and one or more internally facing polariser is removed.
9. A display as claimed in Claim 8 wherein one or more object is introduced to block polarised light to a foreground image.

10. The display as in any one of Claims 1 to 9 with a selective diffuser used to diffuse light which renders a foreground image opaque.
11. The display as in any one of Claims 8 to 10 with selective diffusion layer which renders a foreground image requiring polarised light transparent by blocking polarised light.
12. A display as claimed in any one of Claims 1 to 11 incorporates digital or analog depth extracting techniques from 2d images.
13. A display as claimed in any one of Claims 1 to 12 which incorporates digital or analog depth extracting techniques from 2d images were amount of change to pixel from previous and next frame indicate amount of depth to assign.
14. A display as claimed in either Claim 12 or Claim 13 where the amount of focus in a subset of pixels indicates the amount of depth to assign.
15. The display as claimed in any one of Claims 12 to 14 where the amount of sharpness in a subset of pixels indicates the amount of depth to assign.
16. A display substantially as herein described with reference to and as illustrated by the accompanying drawings.

13

**PATENT COOPERATION TREATY**  
**PCT**  
**INTERNATIONAL PRELIMINARY EXAMINATION REPORT**  
(PCT Article 36 and Rule 70)



Applicant's or agent's file reference 15994/3X058	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).	
International application No. <b>PCT/NZ98/00098</b>	International filing date ( <i>day/month/year</i> ) 10 July 1998	Priority Date ( <i>day/month/year</i> ) 9 April 1997
International Patent Classification (IPC) or national classification and IPC  <b>Int. Cl. <sup>7</sup> G02B 27/22, H04N 13/00</b>		
Applicant <b>Pita WITEHIRA</b>		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.	
2. This REPORT consists of a total of 4 sheets, including this cover sheet.	
<input type="checkbox"/>	This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).
These annexes consist of a total of sheet(s).	
3. This report contains indications relating to the following items:	
I	<input checked="" type="checkbox"/> Basis of the report
II	<input type="checkbox"/> Priority
III	<input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
IV	<input type="checkbox"/> Lack of unity of invention
V	<input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
VI	<input type="checkbox"/> Certain documents cited
VII	<input type="checkbox"/> Certain defects in the international application
VIII	<input type="checkbox"/> Certain observations on the international application

Date of submission of the demand 31 August 1999	Date of completion of the report 10 March 2000
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer  <b>M.E. DIXON</b> Telephone No. (02) 6283 2194

**I. Basis of the report****1. With regard to the elements of the international application:\***

- ☒ the international application as originally filed.
- ☐ the description,        pages , as originally filed,  
                                         pages , filed with the demand,  
                                         pages , received on    with the letter of
- ☐ the claims,        pages , as originally filed,  
                                         pages , as amended (together with any statement) under Article 19,  
                                         pages , filed with the demand,  
                                         pages , received on    with the letter of
- ☐ the drawings,        pages , as originally filed,  
                                         pages , filed with the demand,  
                                         pages , received on    with the letter of
- ☐ the sequence listing part of the description:  
                                         pages , as originally filed  
                                         pages , filed with the demand  
                                         pages , received on    with the letter of

**2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.**

These elements were available or furnished to this Authority in the following language which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

**3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, was on the basis of the sequence listing:**

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

**4. ☐ The amendments have resulted in the cancellation of:**

- ☐ the description,        pages
- ☐ the claims,        Nos.
- ☐ the drawings,        sheets/fig.

**5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\***

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. Statement**

Novelty (N)	Claims 3-5, 7, 13, 15, 16	YES
	Claims 1, 2, 6, 8-12, 14, 17-21	NO
Inventive step (IS)	Claims 4, 5, 13, 15, 16	YES
	Claims 1-3, 6-12, 14, 17-21	NO
Industrial applicability (IA)	Claims 1-21	YES
	Claims	NO

**2. Citations and explanations (Rule 70.7)****NOVELTY**

- WO 91/12554 discloses all the features of claims 1, 2, 6, 8, 9, 11, 12, 21. See in particular page 7 line 31 - page 9 line 33 and figs 4, 5.
- TOMOHIKI HATTORI et al : "SPATIAL MODULATION DISPLAY USING SPATIAL LIGHT MODULATORS" discloses claim 1. The foreground one of the multilayer SLM's is selectively transparent - see in particular figs 1, 3.
- JP 62-235929 (abstract) discloses claim 1.
- EP 454423 discloses claims 1, 6, 21. See col 3 lines 15-40 and figs 4, 5.
- JP 02-262119 (abstract) discloses claim 1.
- EP 195584 discloses claims 1, 6, 8, 12, 21. See page 7 line 28 - page 12 line 13 and figs 1, 2.
- WO 91/15930 discloses claims 1, 6, 21. See pages 2-4.
- US 4472737 discloses claims 1, 2, 21. See col 2 line 61 - col 4 line 53 and figs 1-6.
- US 4333715 discloses claims 1, 2, 6, 8, 10-12, 14, 21. See col 6 line 12 - col 9 line 64 and figs 1-3.

Continued:



**Supplemental Box**

(To be used when the space in any of the preceding boxes is not sufficient)

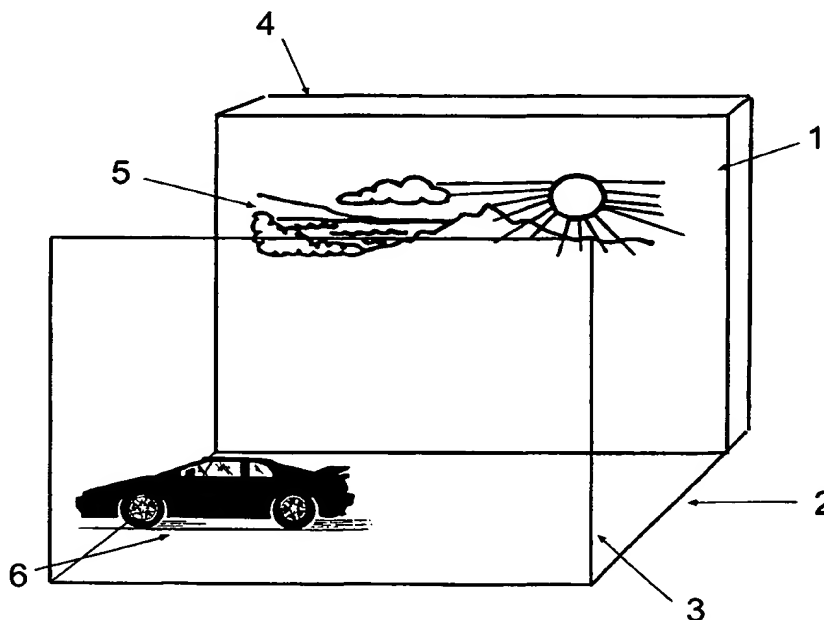
**Continuation of Box V****INVENTIVE STEP**

- In view of WO 91/12554 claims 3, 7, 10 lack inventive step since the features would be obvious to a person skilled in the art.
  
- In view of the above novelty citations, claims 17-21 lack inventive step since depth extraction techniques are features of common knowledge readily available to a skilled person. See, for example, page 6 lines 13-19 of the description.

## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b> <b>G02B 27/22, H04N 13/00</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 99/42889</b> <b>(43) International Publication Date:</b> 26 August 1999 (26.08.99)
<b>(21) International Application Number:</b> PCT/NZ98/00098 <b>(22) International Filing Date:</b> 10 July 1998 (10.07.98)  <b>(30) Priority Data:</b> 329817                      20 February 1998 (20.02.98)      NZ 329834                      24 February 1998 (24.02.98)      NZ  <b>(71) Applicant (for all designated States except US):</b> POWER BEAT INTERNATIONAL LIMITED [NZ/NZ]; Airport Road, RD2, Mistery Creek, Hamilton (NZ).  <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> WITEHIRA, Pita [NZ/NZ]; Devine Road, RD 3, Hamilton (NZ). ENGEL, Gabriel, Damon [US/NZ]; 8 Clare Street, P.O. Box 784, Cambridge (NZ).  <b>(74) Agent:</b> SIMS, Anthony, W.; 29 Clarence Street, Private Bag 3140, Hamilton 2001 (NZ).		<b>(81) Designated States:</b> AU, BR, CA, CN, CZ, DE, DK, ES, GB, IL, JP, KP, KR, MX, NZ, RU, SE, SG, US, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i>

**(54) Title:** A MULTI-LAYER DISPLAY AND A METHOD FOR DISPLAYING IMAGES ON SUCH A DISPLAY



**(57) Abstract**

A display comprising of multi-levels of screens, each screen being selectively transparent with the ability to display images. A method of defining screen layers for upon which to display image on by using sequential time based pixel change as a variable which defines layer.

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav	TM	Turkmenistan
BF	Burkina Faso	GR	Greece		Republic of Macedonia	TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's	NZ	New Zealand		
CM	Cameroon		Republic of Korea	PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

## A MULTI-LAYER DISPLAY AND A METHOD FOR DISPLAYING IMAGES ON SUCH A DISPLAY

### TECHNICAL FIELD

This invention relates generally to display devices and more particularly, to a display structure comprising multi-layered images and a method of extracting depth from two dimensional video data to display on such a device.

### BACKGROUND ART

Conventional display devices present images on a two dimensional screen. Common displays are cathode ray tubes (CRTs), liquid crystal displays (LCDs), Field Effect Displays (FEDs), and projection displays, among others. Various attempts have been made to incorporate the illusion of depth on two dimensional displays. These methods achieve the illusion of depth by presenting separate images to each eye of the viewer.

The main methods of achieving the illusion of depth have been stereoscopic and auto-stereoscopic displays.

Stereoscopic displays generally use composite images which are split into two images by glasses worn by the viewer. Each eye piece in the glasses will allow certain characteristic light patterns through to each individual eye. Popular methods of achieving this are through the use of polarisation, shutter glasses, defraction grating, multi colour lens, and dual screen head mounted displays.

Auto-stereoscopic displays do not use glasses but instead generally use a lens configuration in which stereo images on a screen are aligned through lens or optical grating to focus in the general area of the viewers' individual eyes.

One main problem associated with these displays reside in the inability to gain convergence of stereo images to match the distance between the viewers' eyes. Incorrect convergence leads to disorientation and possible nausea when viewed for extended periods. In the case of most auto-stereoscopic displays the viewing area is limited to the focal length of the lens used. This limits the number of simultaneous viewers of a single screen. Traditional auto stereoscopic displays are limited to one or two simultaneous viewers. While, traditional stereoscopic displays require all users to wear glasses. In addition each of these methods require head tracking devices to be incorporated in order to achieve motion parallax.

Certain designs have been made that use multiple levels of images.(US Patent 4,736,214) These designs incorporate reflected images from single or multiple sources. The reflected images of these designs produce "ghostly" multi layered images, which are generally unacceptable for normal lighting conditions.

Images transmitted to these display devices via antenna, VCR, cable etc. are generally compressed during transmission. It is common for these compression algorithms to compress based on pixel change between consecutive frames.

It is an object of the present invention to address the foregoing problems or at least to provide the public with a useful choice.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only.

### DISCLOSURE OF INVENTION

It is the purpose of this invention to specify a display which improves upon the limitations of display devices mentioned above, while incorporating actual depth.

- 5 According to the present invention depth is created by combining multiple layers of selectively transparent screens. Each screen is capable of showing an image. Each foreground screen is also capable of becoming transparent.

- 10 The preferred embodiment of this invention creates an improved display device incorporating depth, by combining multi-layers of selectively transparent screens to create true depth while incorporating common compression algorithms to extract images into separate channels to be displayed on each screen of the multi-layered display. Implementation of multiple techniques have been  
15 used to achieve this end, which solve many problems exhibited in the prior art.

- Reference throughout this specification will now be made to the present invention as utilising LCDs for each screen layer. However, it should be appreciated by those skilled in the art that  
20 other types of screens that can selectively show an image and selectively become transparent may be used in conjunction with the invention, not necessarily being LCDs.

- In a preferred embodiment of the present invention the screens are aligned parallel to each other with a pre-set distance between them.  
25 This distance depends on the level of desired depth related to the screen sizes. Typically this distance is  $\frac{1}{4}$  the vertical height of the front screen although the actual distance may be changed to fit the desired effect. The distance between screens may also be varied in real time to enhance the effect.

Images displayed on the screen furthest from the viewer (background screen) will appear at some depth behind images displayed on the screen closest to the viewer (foreground screen). The transparent portions of the foreground screen will allow  
5 viewers to see images displayed on the background screen.

This arrangement of layering multiple screens allows images to be presented at multiple levels giving the viewer true depth without use of glasses or lens. It also allows for motion parallax without head tracking devices.

10 Additional layers may be added to give greater depth to the display.

In addition a refractor may be placed between the screens to increase viewing angle. This refraction layer bends light such that viewing angle is increased to the full size of a screen placed in front of the refractor. The refractor may be a parallel sheet of optically  
15 clear material or any other type of lens including fresnel lens.

If the foreground screen device chosen requires a polarised light source to display an image then that polarised light source may emanate from a background screen. This is accomplished by placing a polarisation sheet in front of a non-polarised screen or using a  
20 polarised light output display such as an LCD as the background screen.

Polarised light emanating from a background screen allows a foreground screen of LCD structure to remove its rear polariser while still displaying an image. This is due to the fact that the  
25 background screen provides the polarised light necessary to produce a viewable image on the foreground screen.

Removing the number of polarisers in an LCD configuration has the advantage of reducing the number of components and increasing the brightness of the display.

In such a configuration the foreground image will no longer appear on the foreground screen if the polarised source is blocked. By placing a highly diffuse material between the polarised light source and the foreground screen the foreground images will disappear  
5 where the polarised light is blocked. This gives the illusion that the foreground image displayed is passing behind the diffusion source. To enhance the effect the diffuser may also contain an image.

For example, the foreground screen displays an arrow moving from the left to the right of the screen. Inbetween the foreground screen  
10 and the polariser is placed an image of an apple printed on a diffuse material. When the arrow is in a position to have its polarised light source blocked by the diffusion material it will appear to fall behind the apple imprinted on such diffusion device.

By using a selective diffuser in place of the diffusion material one  
15 may selectively diffuse images presented on the rear screen allowing for infinite depth to be conveyed.

When multiple layered LCDs are used the polarisers of said LCDs must align in such a way that the polarisation angle of the background LCD aligns with the polarisation angle of the rear of a  
20 foreground LCD. Aligning polarisers is not necessary in cases where high brightness is desired or if the foreground image can be inverted. In this case an inverted foreground image will appear non inverted (inverse of an inverted image = non inverted image).

It may be necessary in certain screen combinations to include a  
25 slightly diffuse layer to eliminate moiré interference patterns. This has the additional effect of eliminating the need to align polarisers and increasing angle of view.



Each layer of the display will have an individual video signal. These signals may originate from separate sources or be extracted from a single source conventional signal.

5 In a two layer display using separate sources the background may be transmitted as a signal and the foreground transmitted as a second signal to their respective screen. For example, the background image may be of a mountain and the foreground image of a car passing in front of the mountain.

10 Separate sources may be filmed with multiple conventional cameras, or three dimensional cameras, or blue screen, or chroma key or alpha channel or any combination of industry standard cameras.

15 Single source depth extraction may be performed using conventional compression algorithms used in transmission of video data. Prior Art video compression algorithms commonly utilise pixel change between consecutive frames in order to reduce the bandwidth of the data transmitted. This data on pixel change taken from the video compression algorithm can be used to extract depth based on the amount of change each pixel undergoes.

20 Compressed signal is sent to display where video streams to each layer are extracted from the signal based on pixel change.

For example, a standard video may be made of a car passing a mountain. The camera is fixed such that the car passes the field of view while the mountain remains still in the frame.

25 In such a video the pixels representing the passing of the car will change whereas the pixels representing the mountain will remain constant. Thus, the pixels with the most change (car) will be assigned to the foreground screen where the pixels with the least change (mountain) will be assigned to the background screen.

It should be understood that portions of this summary devoted to polarisation are not limited to LCD structures as it can be easily understood by those skilled in the art that other non polarised displays may be adapted to incorporate certain polarisation characteristics if so desired.

Further more, it is easily understood by those skilled in the art that the above summary covers the use of all screen types not only LCDs. The only requirement for the screen type is an ability to be transparent. As such it should be understood to cover, but is not limited to Projection, CRT, FED and LCD screens.

#### **BRIEF DESCRIPTION OF DRAWINGS**

Further aspects of the present invention will become apparent from the following description which is given by way of example only and with reference to the accompanying drawings in which:

Figure 1 is a diagrammatic view of a basic multi-layered display in accordance with one embodiment of the present invention.

Figure 2 illustrates a multi-layered screen with a refractor in accordance with one embodiment of the present invention.

Figure 3 illustrates the moiré interference pattern in multi-layered displays in accordance with one embodiment of the present invention.

Figure 4 illustrates a diffuser and its effect on the moiré interference pattern in accordance with one embodiment of the present invention.

Figure 5 illustrates a multi-layer display with added depth in accordance with one embodiment of the present invention.

5 Figure 6 illustrates a multi-layered display with added clarity in accordance with one embodiment of the present invention.

Figure 7 illustrates a tri-level display in accordance with one embodiment of the present invention.

10 Figure 8 illustrates a method of displaying images to each screen level in accordance with one embodiment of the present invention.

#### **BEST MODES FOR CARRYING OUT THE INVENTION**

In the following, detailed descriptions of the preferred embodiments of this invention are revealed. Although a complete specification is revealed it should be understood by those skilled in the art that  
15 each aspect of the preferred embodiments may be used independently or in conjunction with other illustrations of this invention while still conforming to the general specification of a multi-layered display device.

20 The preferred embodiments of this invention create an improved display device incorporating depth, by combining multi-layers of selectively transparent screens.

A simplified multiple layered image display is shown in Figure 1. A background screen 1 is placed at some distance 2 behind a  
25 foreground screen 3. In some display types such as LCDs back lighting 4 may be required. Each screen is capable of showing images 5, 6. Images displayed on the foreground screen 6 appear to be closer than images shown on the background screen 5.

The addition of a refractor placed between screens is represented in Figure 2. Light 7 transmitted to the viewer 8 is bent to 9 at refraction angle 10 of the material such that the edge of the rear screen is not seen from any angle of view. Without the refraction of light the edge of the rear screen would be clearly seen 11 from any angle less than 90 degrees.

For minimum distortion a sheet of parallel optically clear material such as glass or acrylic may be used as a refractor 12. Such a refractor would restrict the front screen 3 to being of a smaller size than the background screen 1. In a preferred embodiment of the present invention the foreground screen size would have its edge no less than 135 degrees from the edge of the rear screen.

In another preferred embodiment the refractor may be a lens including but not limited to fresnel. In this embodiment the screens may be of similar size.

The addition of a slightly diffuse layer 13 placed between screens is shown in Figure 4. Without this layer, interference 14 is created by the combination of slightly different pixel patterns of subsequent screen layers. Placing the diffusion layer 13 between screens slightly diffuses the pixel pattern in each screen eliminating interference 15.

Alternately interference can be eliminated by using a stripe pixel pattern on one screen and a 45 degree diagonal pixel pattern on another.

For further clarification a complete assemble is shown in Figure 5. This combination produces a display with a finite true depth defined by the distance between screens 3, 6. It also creates an infinite depth illusion with the addition of a selective diffuser.

A polariser sheet 17 is placed at the front of the rear screen 1. This creates a polarised light source. Alternately the rear screen could also be an LCD with a polarised output. In front of the polariser is placed a selective diffuser 18. In front of the diffuser is a refractor 8. In front of the refractor is placed a LCD without a rear polariser 16.

When the selective diffuser is set to transparent, the rear screen outputs polarised light to allow an image on the foreground screen to be visible.

When the selective diffuser is set to diffuse, the rear screen polarised light output is converted to diffuse light, which renders the foreground image invisible.

With certain screen technologies such as LCD it is desirable to have the ability to render the foreground screen opaque. This preferred embodiment is represented in Figure 6. This combination produces a display in which the foreground screen is rendered opaque. In this configuration the rear screen 1 is followed by a refractor 12 which is followed by a selective diffuser 18 which in turn is followed by the foreground screen 3. To make images on the foreground screen opaque the selective diffuser is selected to diffuse the area behind the area selected to be opaque.

In yet another embodiment of the present invention Figure 6 represents a Tri-layer display incorporating most of the previously mentioned techniques. This display provides three finite depth planes with the foremost screen 19 being selectively opaque due to the selective diffuser 18 placed behind it. The middle LCD screen 16 would have infinite depth due to its lack of rear polariser and the ability of the selective diffuser 18 in front of the rear polariser 17 to diffuse polarised light required for its operation.

The general method of transmitting images to the screens is represented in Figure 8. Image 19 is transmitted to the background screen 1. Image 20 is transmitted to the foreground screen 3.

- 5 Alternatively the separate video signal can be extracted from a single image using data produced by most common video compression algorithms. For example a video signal is transmitted of a car passing in front of a mountain 21, creates a sequence of frames 22. This sequence is fed through a video compression  
10 algorithm 23 which converts the image to a sequence of numbers representing pixel properties such as pixel colour, pixel location and amount of pixel motion between consecutive frames.

In this example, pixels with a change value above a threshold of X via path 24 to the foreground screen while pixels with a change  
15 value below X are sent via path 25 to the background screen. In the present implementation (Figure 8) pixels representing the car have a high value for pixel change and will be directed to the foreground screen and the mountain having a pixel change value of less than X will be directed to the background screen.

- 20 It can be easily understood by those skilled in the art that the threshold value and tolerance of this value may be adjusted to gain a variety of outputs. In addition multiple threshold values may be defined in multi-layered displays with over two layers.

Thus, it can be seen from the foregoing detailed description and  
25 attached drawings that the present invention includes methods of displaying depth in a display allowing for motion parallax, true convergence, and wide angle of view without the viewing restrictions of prior art displays.

It can also be appreciated that taken individually each component enhances the depth of the display but may also operate independently and in combination to enhance traditional displays. It is obvious to someone skilled in the art that the following claims  
5 may be combined in various manners.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof.

**CLAIMS**

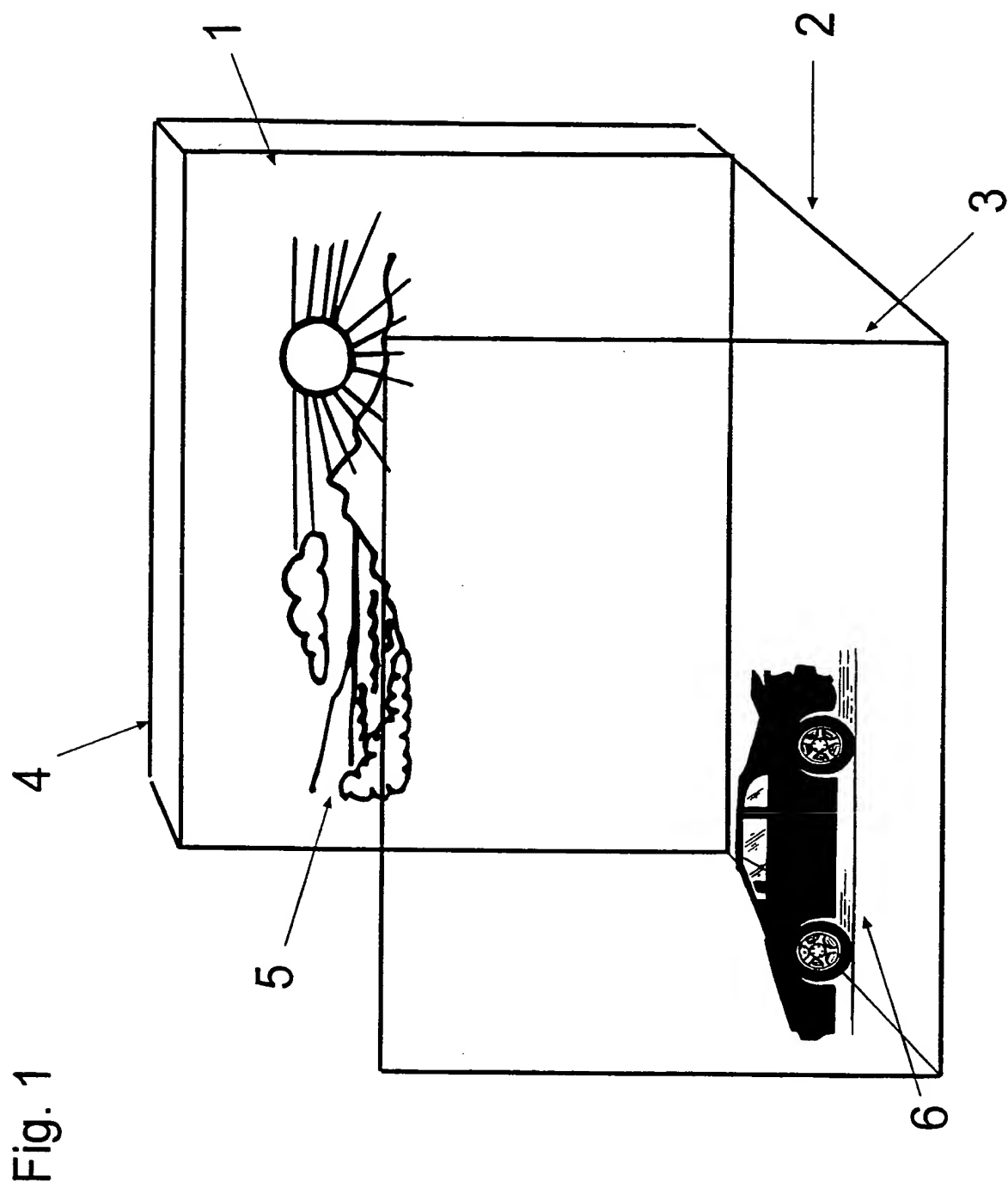
1. A display using multi-layered images each layer formed by a display device or combination of display devices in which the foreground screen(s) is(are) selectively transparent.
2. A display using multi-layered images each layer formed by a display device or combination of display devices in which the foreground screen(s) is(are) selectively transparent with refractor between layers.
3. The display as in Claim 2 with said refractor being of optically clear material placed between images such that the image in the foreground is no less than 45 degrees from the edge of the screen to its rear.
4. The display as in Claim 2 with said refractor being a fresnel lens
5. The display as in Claim 2 and Claim 3 with said refractor diffused on the side facing the rear screen.
6. A display using multi-layered images each layer formed by a display device or combination of display devices in which the foreground screen(s) is(are) selectively transparent and the space between images is able to be adjusted in real time.
7. A display using multi-layered images each layer formed by a display device or combination of display devices in which the foreground screen(s) is(are) selectively transparent with layered images being aligned such that a 45 degree angle can be measured in relation to their respective pixel alignment configurations.
8. A display using multi-layered images each layer formed by a polarized display device or combination of polarized display



devices in which the foreground screen(s) is(are) selectively transparent.

9. The display as in Claim 8 wherein said polarisers are aligned such that the polarisers which face each other are aligned to the same polarisation angle.
10. The display as in Claim 8 with said polarisers not aligned.
11. A display using multi-layered images each layer formed by a polarized display device or combination of polarized display devices in which the foreground screen(s) is(are) selectively transparent and internally facing polarisers are removed.
12. A display using multi-layered images each layer formed by a polarized display device or combination of polarized display devices in which the foreground screen(s) is(are) selectively transparent and a single internaly facing polariser is removed.
13. A display using multi-layered images each layer formed by a display device or combination of display devices in which the foreground screen(s) is(are) selectively transparent and slightly diffuse layer placed on the front of a background image.
14. A display using multi-layered images each layer formed by a polarized display device or combination of polarized display devices in which the foreground screen(s) is(are) selectively transparent and a single internaly facing polariser is removed with an object introduced to block polarised light to a foreground image.
15. The display as in Claim 8 with a selective diffuser used to diffuse light which renders a foreground image opaque.

16. The display as in Claim 12 with selective diffusion layer which renders a foreground image requiring polarised light transparent by blocking polarised light.
17. A display using multi-layered images each layer formed by a display device or combination of display devices in which the foreground screen(s) is(are) selectively transparent which incorporates digital or analog depth extracting techniques from 2d images.
18. A display using multi-layered images each layer formed by a display device or combination of display devices in which the foreground screen(s) is(are) selectively transparent which incorporates digital or analog depth extracting techniques from 2d images were amount of change to pixel from previous and next frame indicate amount of depth to assign.
19. The display as in Claim 17 were amount of focus in a subset of pixels indicate amount of depth to assign.
20. The display as in Claim 17 were amount of sharpness in a subset of pixels indicate amount of depth to assign.
21. A display using multi-layered images each layer formed by a display device or combination of display devices in which the foreground screen(s) is(are) selectively transparent and display components are produce non moving images.



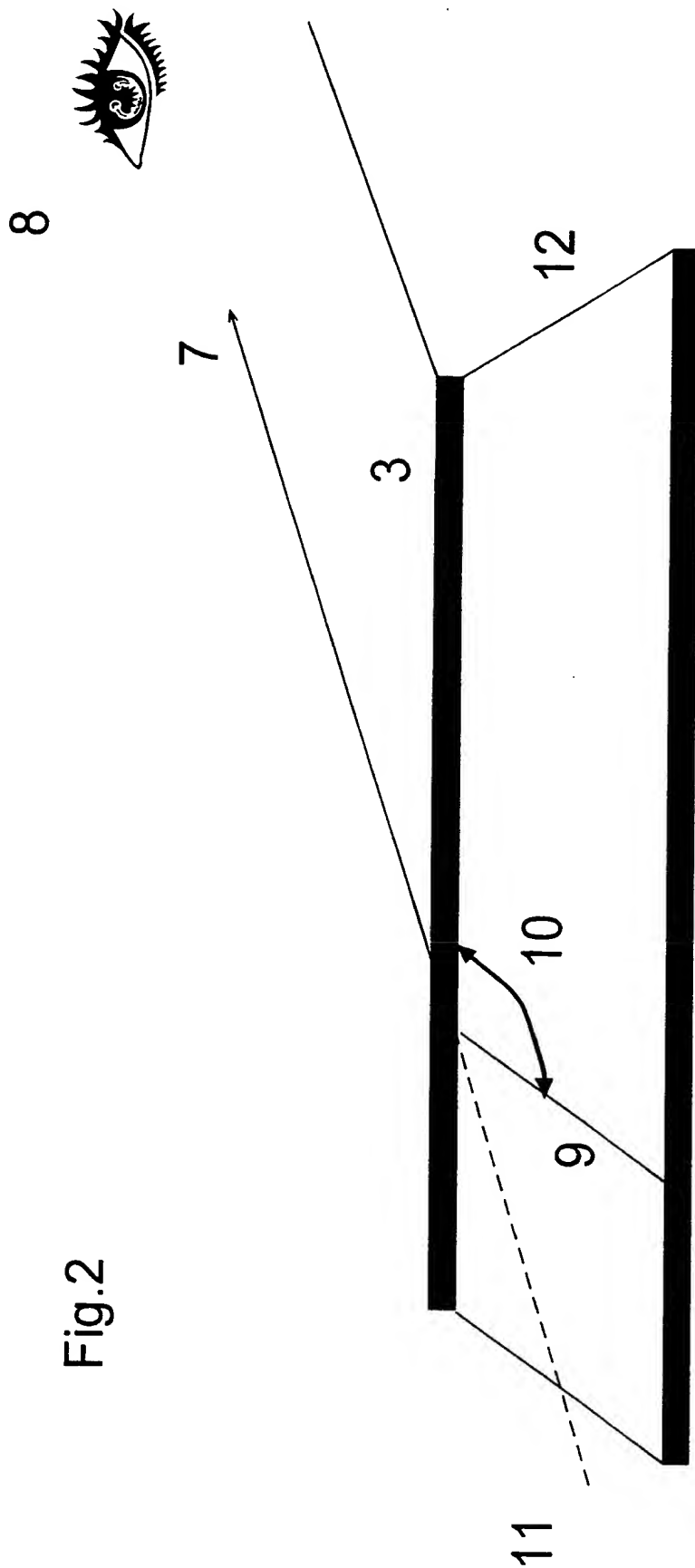


Fig.3

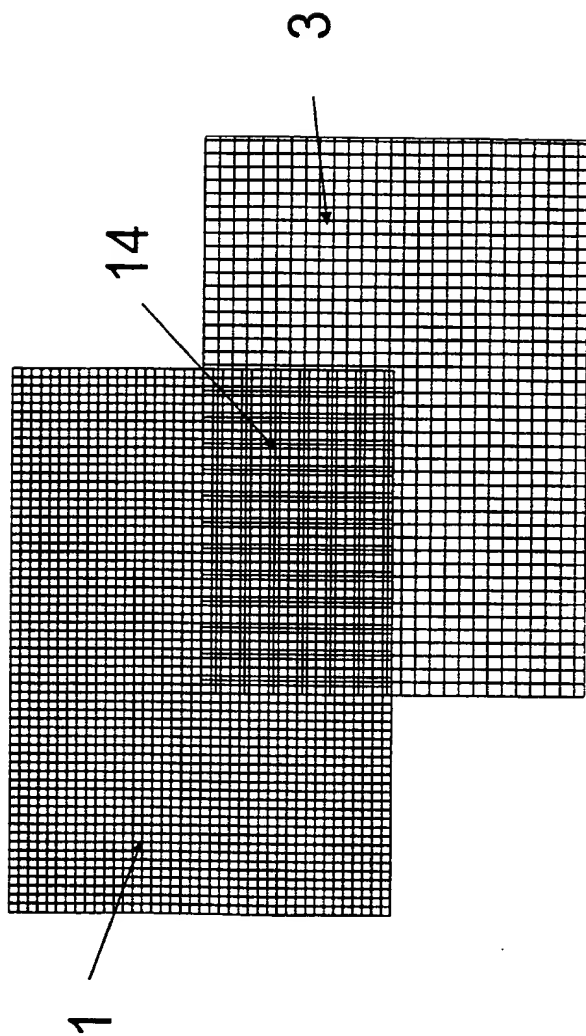
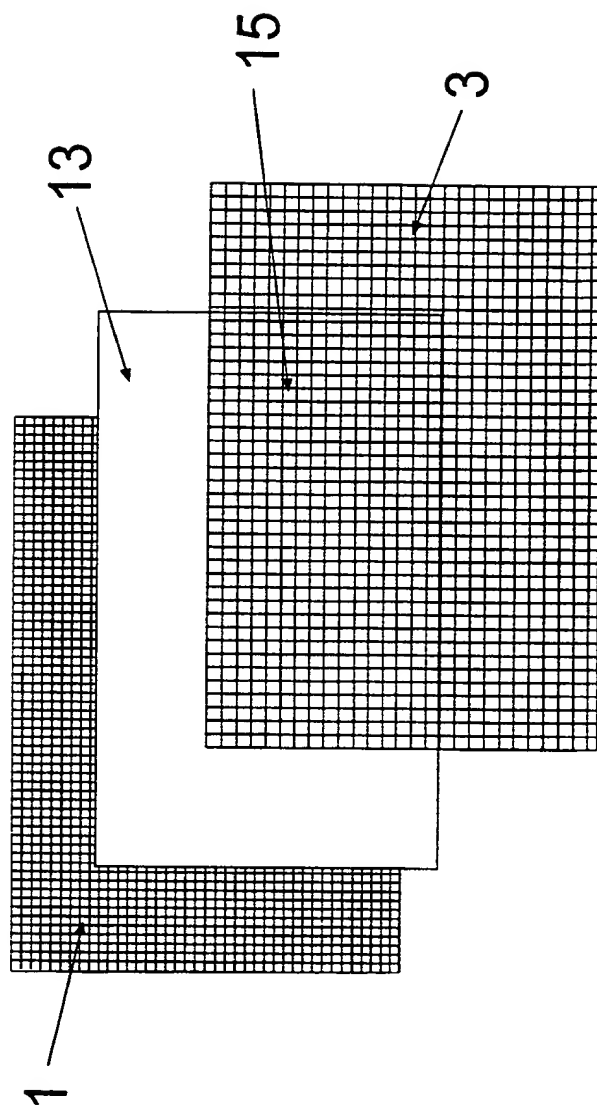


Fig.4



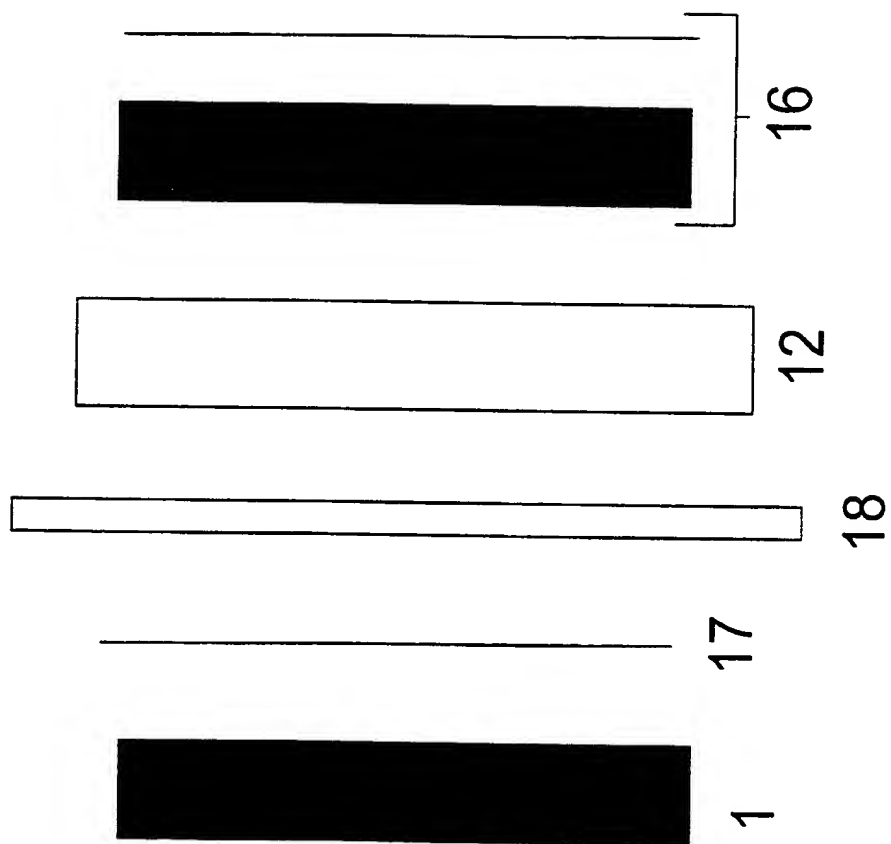


Fig. 5

Fig.6

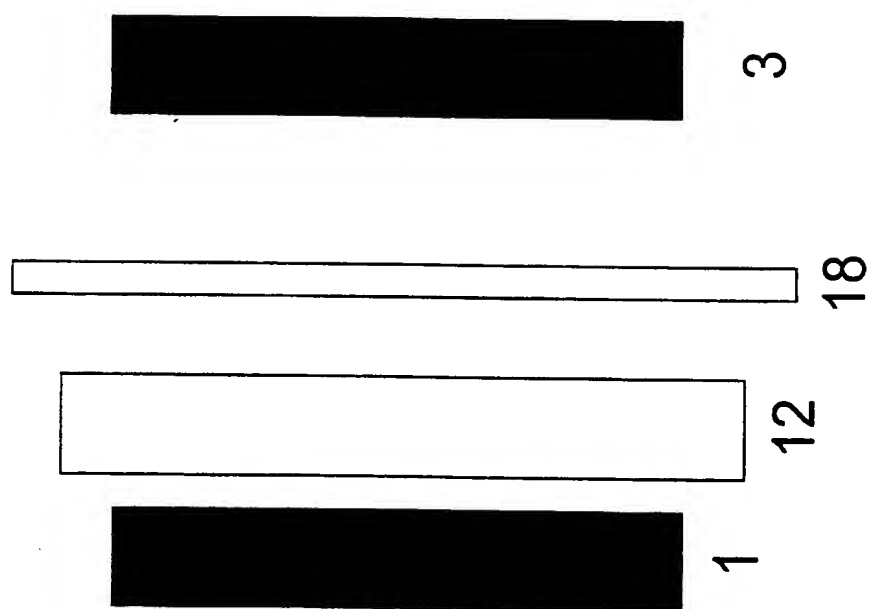


Fig.7

